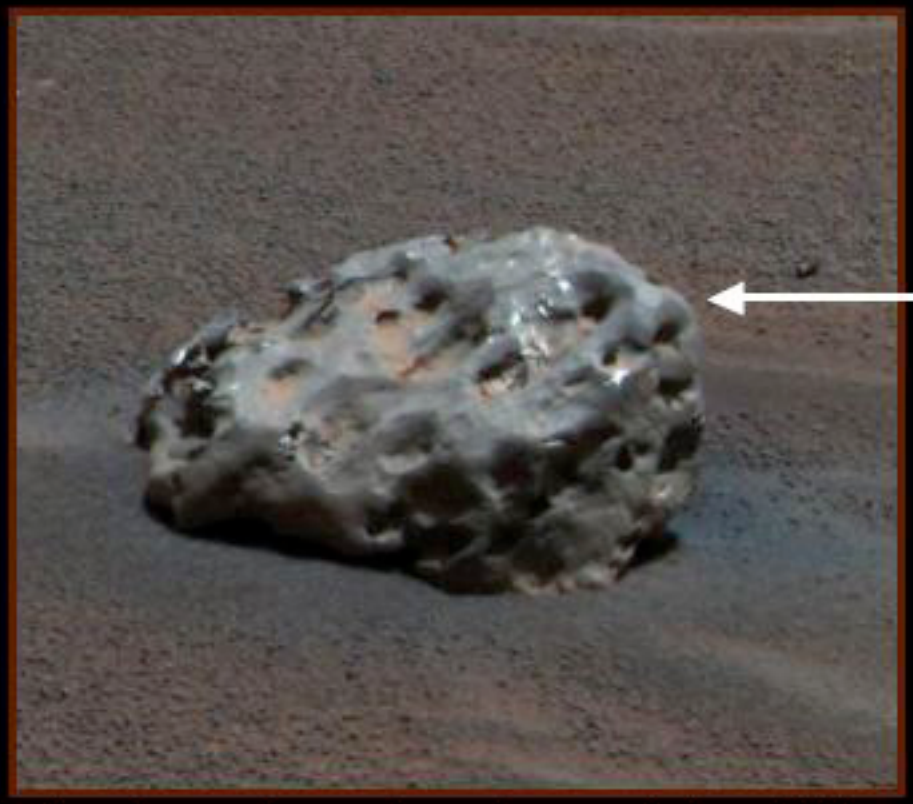
Mars Exploration Rover Mission

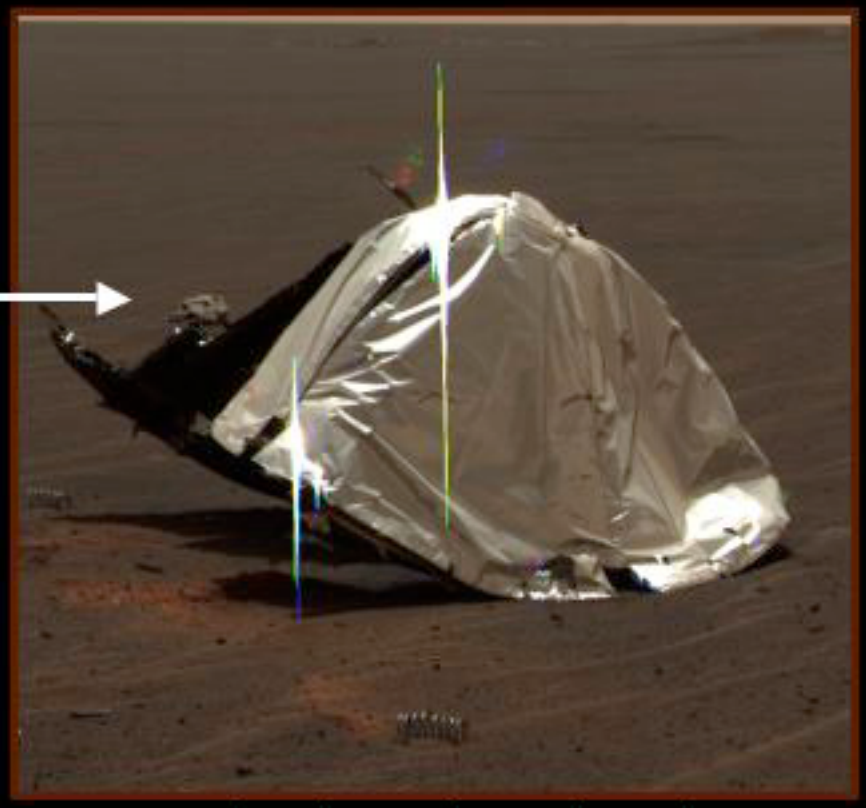
Spirit and Opportunity

Month in Review
January 3, 2005 - January 31, 2005

Opportunity celebrated one year on Mars with an early birthday present from the heavens.



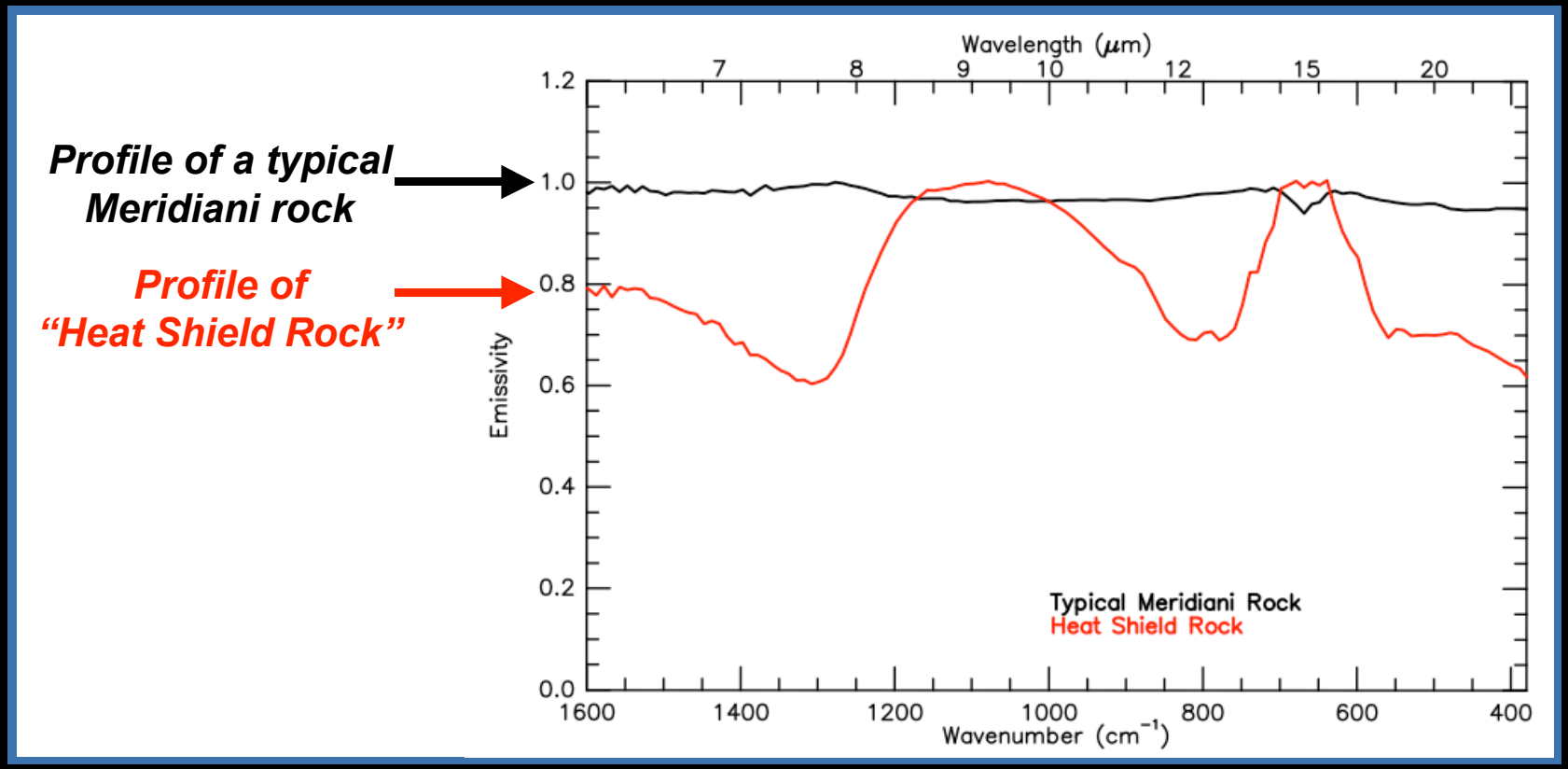
Approximate true-color panoramic camera image composite, January 6, 2005.
NASA/JPL/Cornell



Approximate true-color panoramic camera image.
NASA/JPL/Cornell

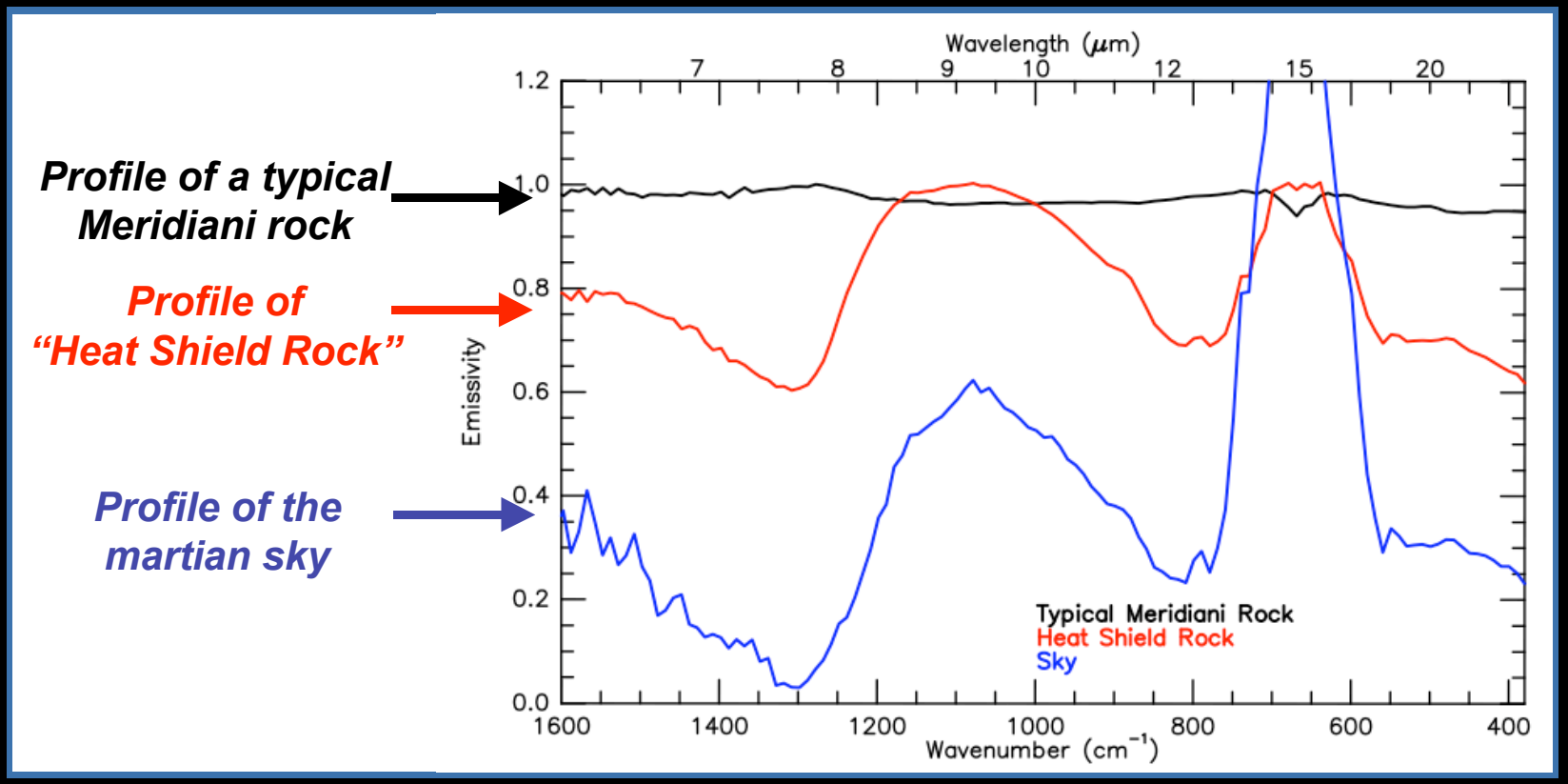
Scientists found the shiny gift next to the rover's discarded heat shield and named it "Heat Shield Rock."

When scientists first measured the rock's composition, they discovered that no other surface material found by Spirit or Opportunity is like Heat Shield Rock.



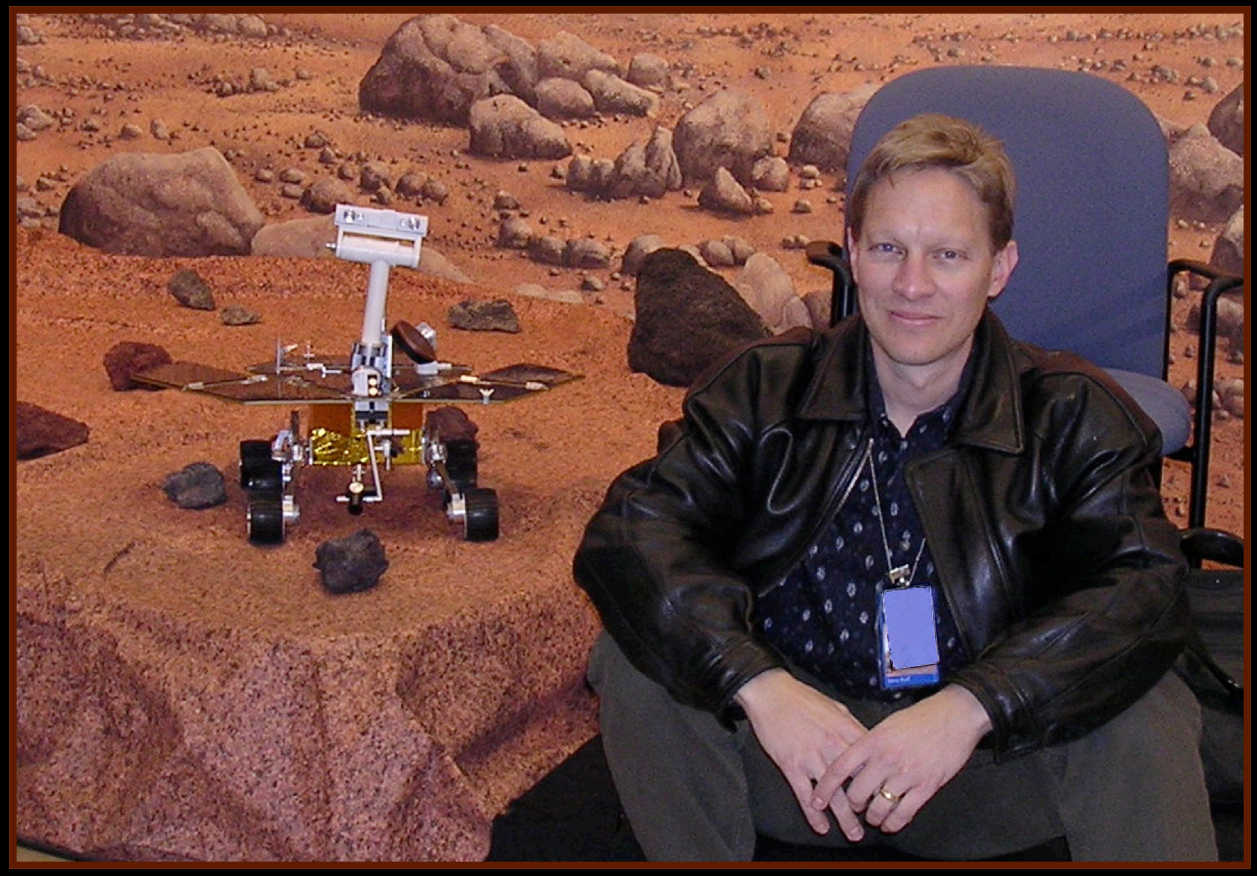
Spectral comparisons of a typical Meridiani rock and Heat Shield Rock, Miniature Thermal Emission Spectrometer. NASA/JPL

Putting on their detective hats, scientists realized that their analysis of the basketball-sized rock looked strikingly similar that of the martian sky.



Miniature thermal emission spectrometer . NASA/JPL

Rover geologists on the mission team such as Steve Ruff know that metals are great reflectors.



Steve Ruff, next to a 1/10th scale model of the rover. NASA/JPL

When the analysis of the rock matched the sky, the team believed that the rock must be made of pure metal and was reflecting the martian sky.

Opportunity continued to study the rock, revealing that it is composed of iron and nickel. The only rocks known to have this much metal are meteorites that come from outer space.

Approximate true-color panoramic camera image composite. NASA/JPL/Cornell

Iron meteorite found at Derrick Peak, Antarctica. NASA

It turns out that Heat Shield Rock is a meteorite that landed on Mars!

Of the 37,000 - 78,000 tons of space material that enters Earth's atmosphere each year, most are dust-sized particles that don't reach the surface.

Comet dust raining down on Earth during the annual Perseid meteor shower.
Copyright: Fred Bruenjes, from NASA's Astronomy Picture of the Day.

The same is probably true for Mars, so finding this meteorite on Mars was exciting for the science team.

The rover team then wanted to know if Opportunity's Rock Abrasion Tool (RAT) could be used to drill into the meteorite without breaking.

Meteorite used to test the Rock Abrasion Tool . Credit: AMNH

Dr. Denton S. Ebel, Meteorite Curator, holding a different meteorite. Credit: AMNH/Photo Studio

Using an engineering model, the team partnered with the American Museum of Natural History to test the RAT on a meteorite found on Earth.

The museum loaned the rover team their "Santa Rosa" meteorite, which was originally found in Colombia in 1810.

Picture of the cut face of the meteorite . Credit: AMNH

Engineers tested on the cut face of the meteorite to measure the wear and tear on the Rock Abrasion Tool.

Engineers discovered that the wear and tear on the grinding bit was very high.

Fresh Grinding Bit

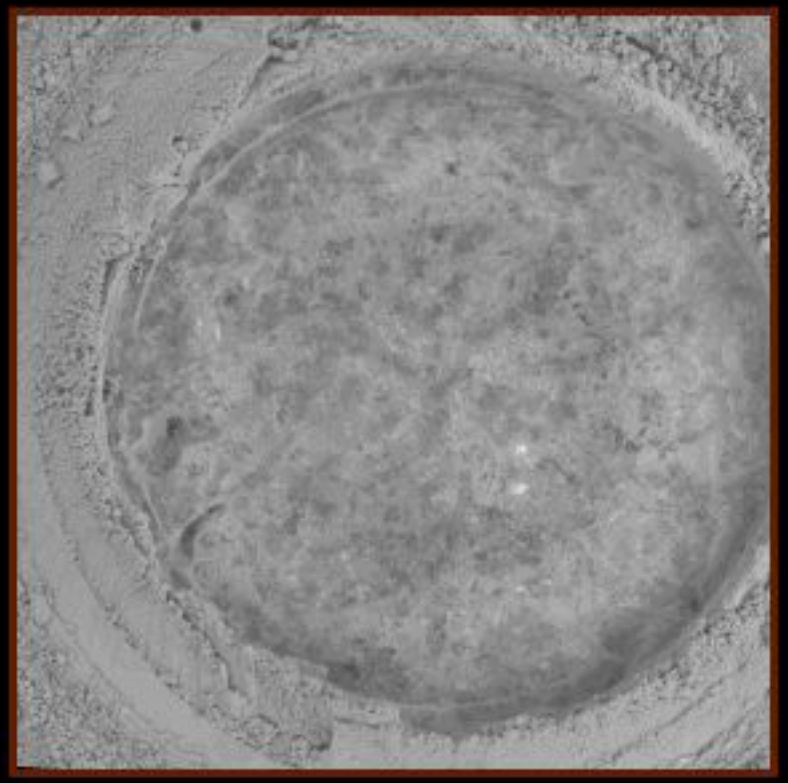
Grinding Bit After 2 Hours

Results, Honeybee Robotics, January 17, 2005.

Thus, rover team members like Phil Chu decided not to grind "Heat Shield Rock" in order to save the RAT for many more martian rocks along Opportunity's continued journey.

RAT engineer and scientist, Phil Chu, next to a full-scale model of the rover. NASA/JPL

Meanwhile, Spirit celebrated its one year anniversary on Mars by popping open the rock "Champagne" with the Rock Abrasion Tool.



Microscopic image of target "Bubbles" on "Champagne," January 3, 2005. NASA/JPL/Cornell

The circular area is about 2 inches (4.5 centimeters) across.

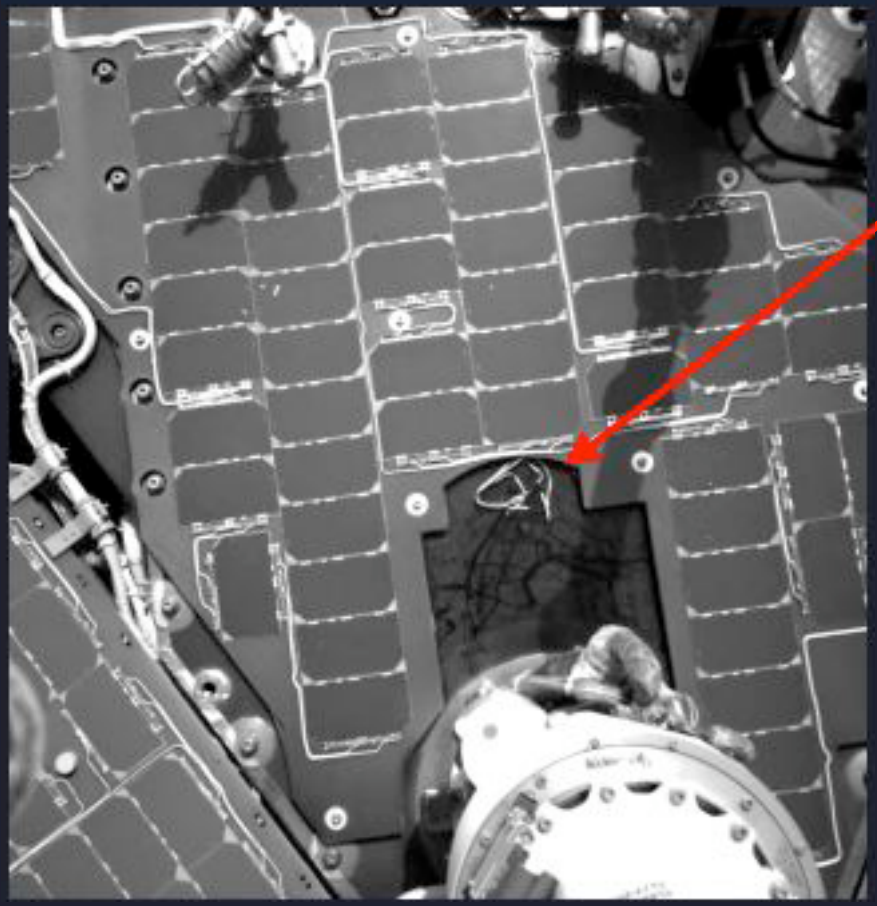
The science team discovered that Champagne is rich in phosphorus, and wants to understand how that may relate to the history of water on Mars.

Spirit celebrated Martin Luther King Day by investigating a rock named “Peace.”

Front-hazard avoidance camera image, January 18, 2005.

Peace was such an unusual rock that the science team decided to study it for over a week. Results are pending.

Spirit has braved the martian dust throughout the year, as proven by a cable tie that has left a trail of streaks in a fine layer of dust on the rover deck.

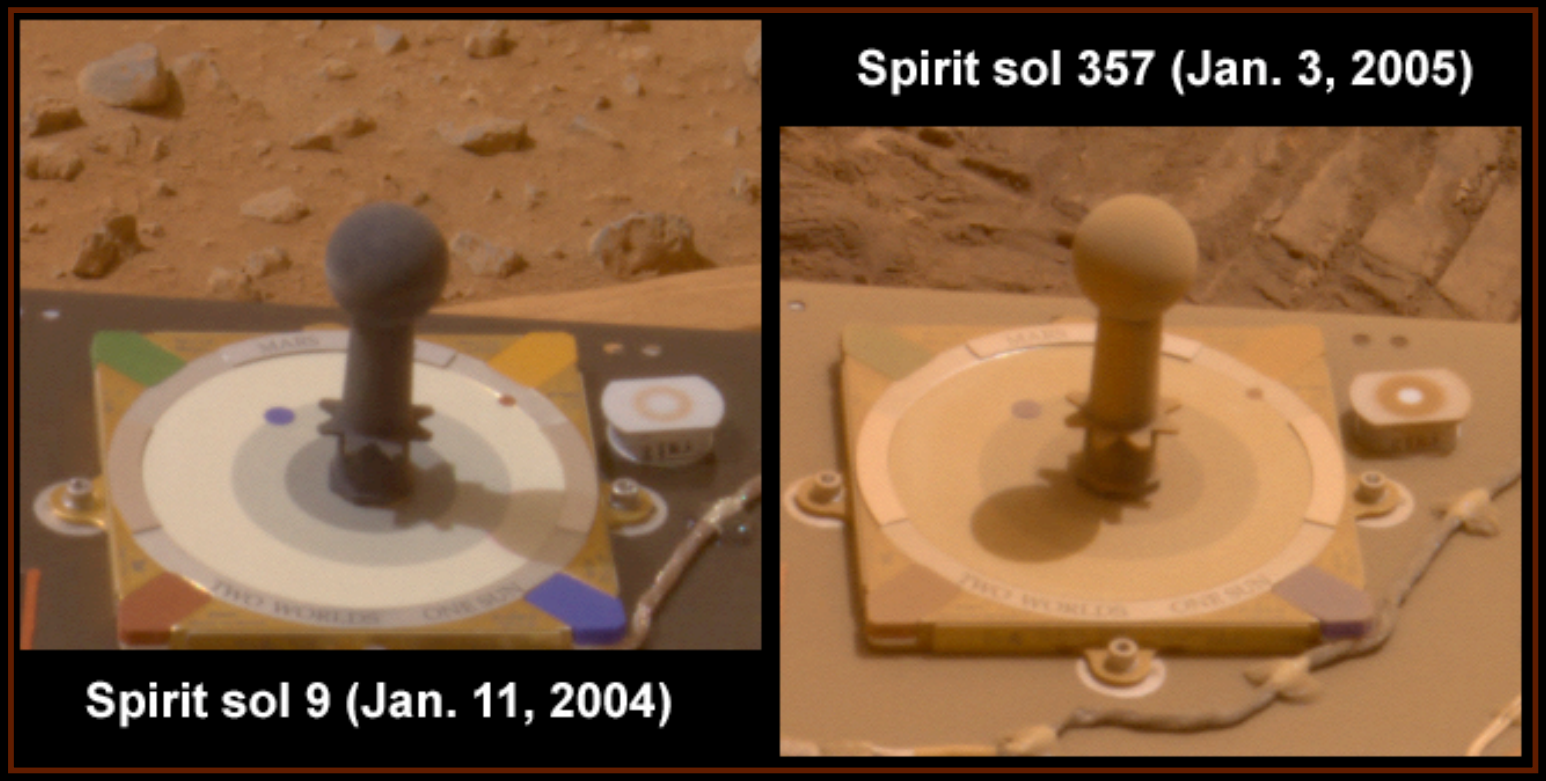


Navigation camera image, January 3, 2005. NASA/JPL

The cable tie, which resembles a wire used to fasten bags around loaves of bread, is one of 1,000 cable ties on the spacecraft.

Engineers speculate the tie sprung loose from some part of the rover during the spacecraft's Entry, Descent, and Landing phase or during the rover's Egress from the lander.

Spirit's calibration target also shows how dust has accumulated on the rovers during the last year.



Panoramic camera images. NASA/JPL/Cornell. The calibration target is used to help scientists color images from Mars correctly.

Spirit's solar panels are coated in dust too, causing its power to decline gradually. On the other side of Mars, Opportunity hasn't been covered with as much dust.

Spirit will continue to climb up the crest of "Husband Hill."

Opportunity is heading south for a small crater referred to as "Argo."

Opportunity's journey south toward a small crater.
Navigation camera image, January 26, 2005, NASA/JPL